Carnegie Mellon
Software Engineering Institute

CMMI ®

Pittsburgh, PA 15213-3890

Introduction to the CMMI® Acquisition Module (CMMI-AM)

Module 1:
Background

Sponsored by the U.S. Department of Defense

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Agenda

Introduction

About this Course

The State of Acquisition Practices

Capability Maturity Model Integration

Introductions

Instructor introductions

Participant introductions

- name

- position

- expectations

  - What do you want to get out of this course?

Agenda

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Course Objectives

To acquaint the PM and PMO staff involved with the acquisition of software intensive systems with the need for process and process management

- at the supplier
- At the acquirer

Provide an overview of the CMMI Acquisition Module

Provide an overview of process improvement methods

Course Contents

Module 1 –   **Background**
Course information and Background

Module 2 –   **CMMI-AM and Project Management**
Project Management process areas, goals, and practices

Module 3 –   **CMMI-AM and Engineering**
Engineering process areas, goals, and practices

Module 4 –   **CMMI-AM and Support**
Support process areas, goals, and practices

Module 5 –   **CMMI-AM Generic Practices**

Module 6 –   **Using CMMI-AM**

Module 7 –   **Summary and Conclusion**

Course Schedule

Time	Topic
0800	Breakfast
0830	1 Background
0915	2 CMMI-AM and Project Management
1000	**Break**
1015	2 CMMI-AM and Project Management (cont'd)
1200	**Lunch**
1300	3 CMMI-AM and Engineering
1430	**Break**
1445	4 CMMI-AM and Support
1545	5 CMMI-AM Generic Practices
1615	6 Process Improvement
1645	7 Summary and Conclusion
1700	**Adjourn**

Audience

Program Managers (PMs)

Program Management Office (PMO) staff

- Engineering

- Contracts

- Logistics

- Finance

- Test

No prior knowledge of CMMI is required
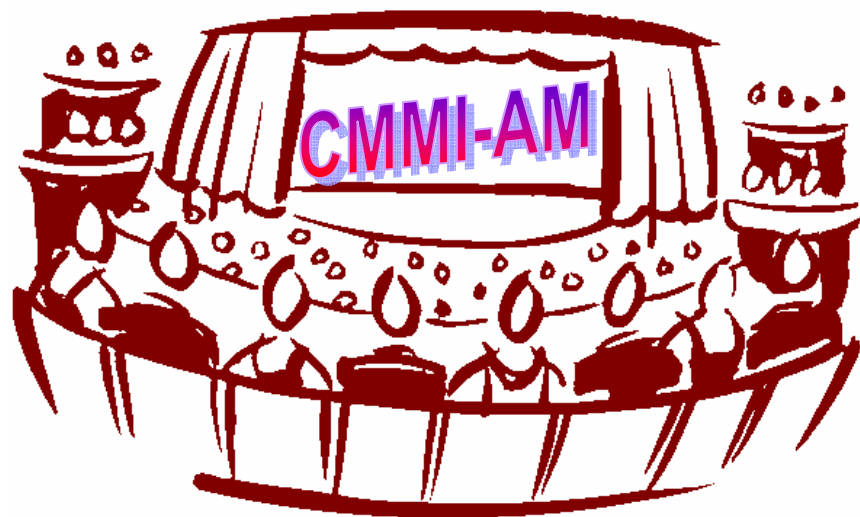
Course Details

Course Approach
- Lecture
- Discussion
- Exercises

Course Materials
- Course Notebook
- CMMI-AM v1.1

Rules of Engagement
- Participate
- One person talks at a time
- Keep discussions to the point
- No attribution

Logistics

Rest rooms

Smoking rules

Breaks

Lunch

Phones

Messages

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What is "Acquisition"

Operational Need

Question: **What are the key activities that you perform when you acquire systems?**
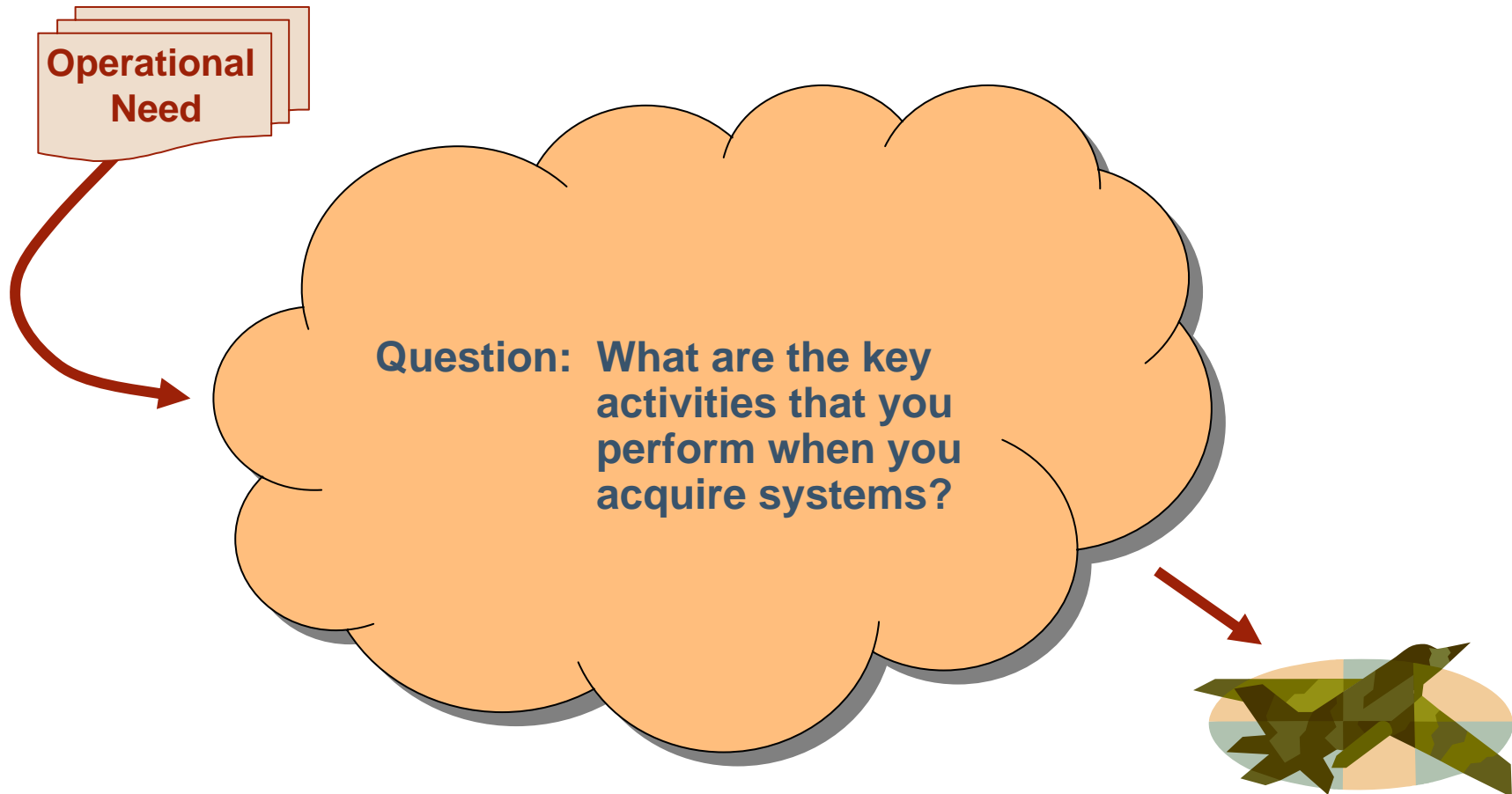
The State of Acquisition Practice [1]

The agencies assume the partnership arrangement absolves them of all acquisition management responsibilities…" [GAO 99]

Virtually all (Air Force) software-intensive systems suffer from difficulties achieving cost, schedule, and performance objectives. [GAO 92]

"I'd rather have it wrong than have it late." A senior manager (industry)

"The bottom line is schedule. My promotions and raises are based on meeting schedule first and foremost." A program manager (government)

Lack of robust systems engineering practices identified as critical factor in SBIRS-High problems. Lt. Gen. Brian A. Arnold, USAF, CDR, USAF/SMC (5/6/02 Aviation Week)

The State of Acquisition Practice 2

Is There an Acquisition Crisis?

Investigation of one acquisition program showed:

- System complexity and the program's lack of experience in procuring major systems caused serious cost growth.

- Program lacks systems engineering and program management expertise.

- Absence of requirements stabilization process.

- Program management does not enforce timely milestones, timelines, and deliverables.

- Program's lack of process control made assessment of technical risk impossible.

- Program's lack of short- and long-term budget tracking makes cost assessment nearly impossible.

- Program does not manage risk.

The State of Acquisition Practice 3

What's the Problem?

There are many. Among them,

- Evidence shows that an **acquirers management processes** and practices and resultant decisions can have a **negative impact** on the development processes of the supplier

- A **mismatch** in Acquirer/Supplier in terms of associated process capability and maturity can have **unpredictable** and even **disastrous results.**

And the challenges are increasing …

Acquirer/Supplier Mismatch

Acquirer (vertical axis: **Low** to **High**)

Supplier (horizontal axis: **Low** to **High**)

Technical & Mg't Skill

	Supplier Low	Supplier High
Acquirer High	**Mismatch** mature acquirer mentors low maturity supplier outcome not predictable	**Matched** acquirer and supplier are both high maturity highest probability of success
Acquirer Low	**Disaster** no discipline no process no product	**Mismatch** Immature | mature acquirer | supplier Customer encourages short cuts.

•M1-Background v0.1

Complexity in Modern Systems

Many commercial products are the result of a complex mix of subcomponents engineered into a system

Most DoD weapon and information systems are *at least* this complex
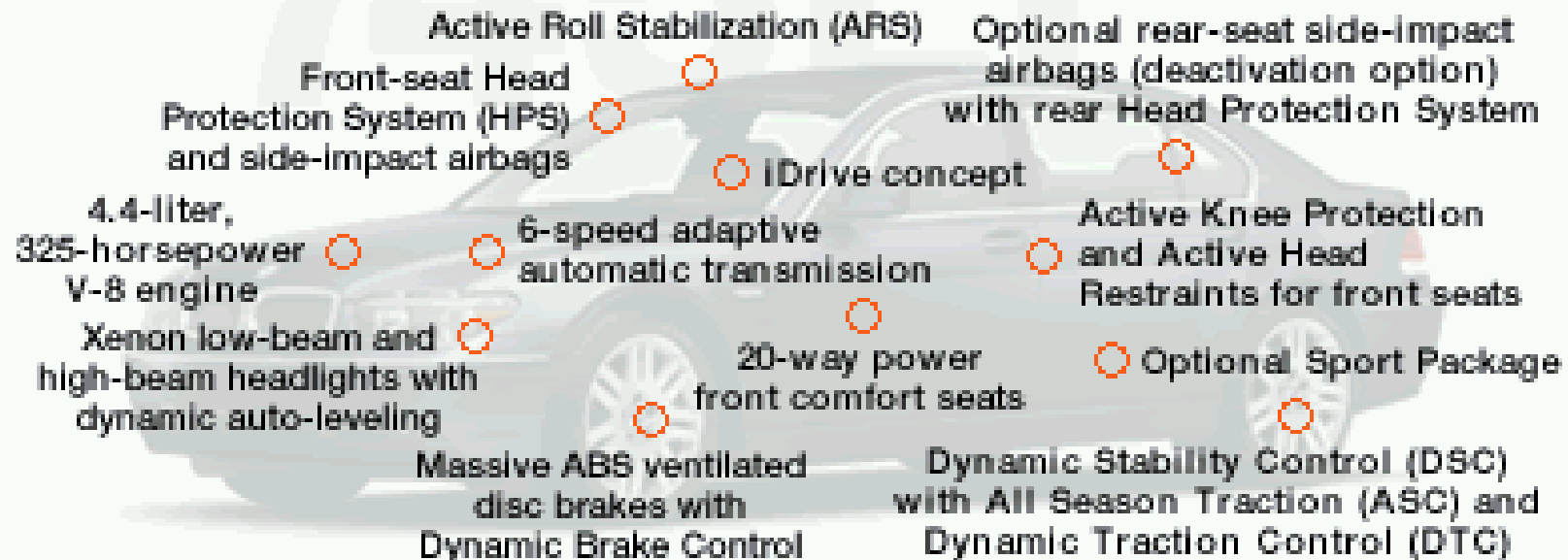
Active Roll Stabilization (ARS)

Front-seat Head
Protection System (HPS)
and side-impact airbags

Optional rear-seat side-impact
airbags (deactivation option)
with rear Head Protection System

iDrive concept

4.4-liter,
325-horsepower
V-8 engine

6-speed adaptive
automatic transmission

Active Knee Protection
and Active Head
Restraints for front seats

Xenon low-beam and
high-beam headlights with
dynamic auto-leveling

20-way power
front comfort seats

Optional Sport Package

Massive ABS ventilated
disc brakes with
Dynamic Brake Control

Dynamic Stability Control (DSC)
with All Season Traction (ASC) and
Dynamic Traction Control (DTC)

Weapon System Complexity

Nuclear, Biological and Chemical/ Environmental Control System

Active Protection System(s)

Core Vetronics / Crew Stations

Auxiliary Systems-Fuel/Water

Structures Upper/Lower Hull

Signature Management

Defensive Armament

Countermeasures

Propulsion - 400kw Engine 23 kW-hr Li Ion Batteries (Shown)

Armor-Conventional/ElectroMagnetic/ Applique

Suspension-Active Damping, Height/Attitude Control & Band Track

Common Systems

FCS Manned Ground Vehicle concept

•M1-Background v0.1

System of Systems Complexity
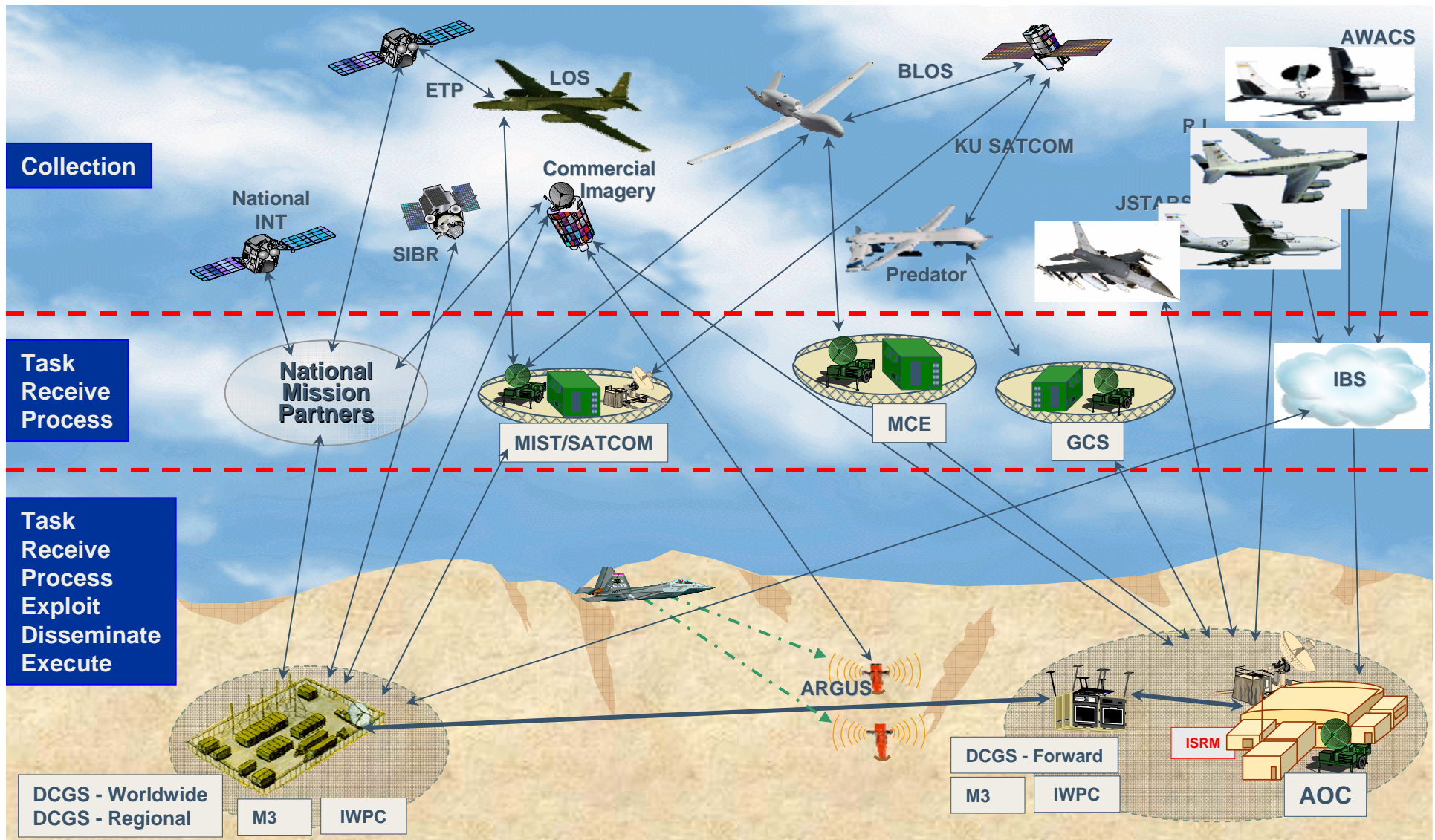
Increasing System Complexity
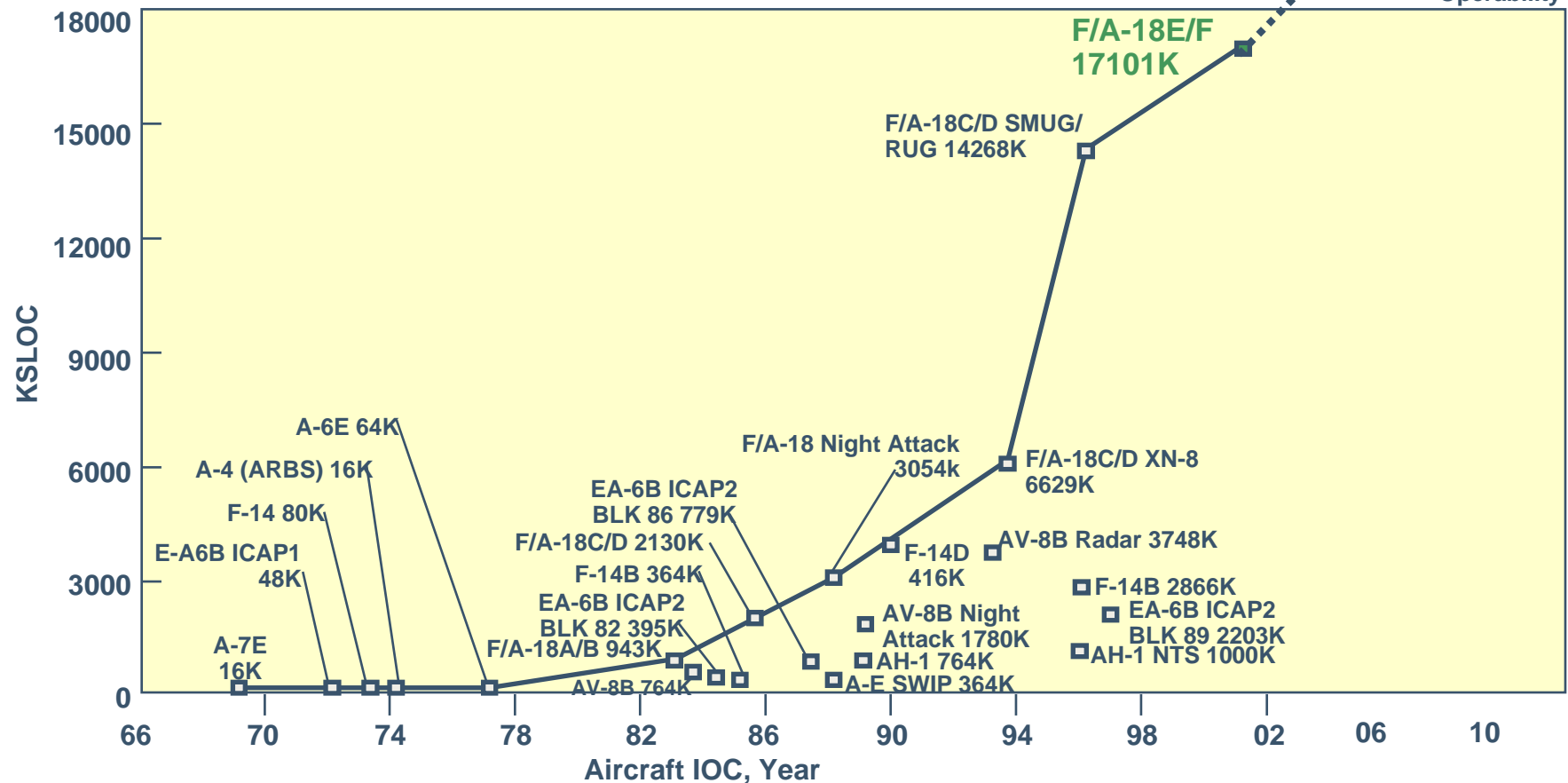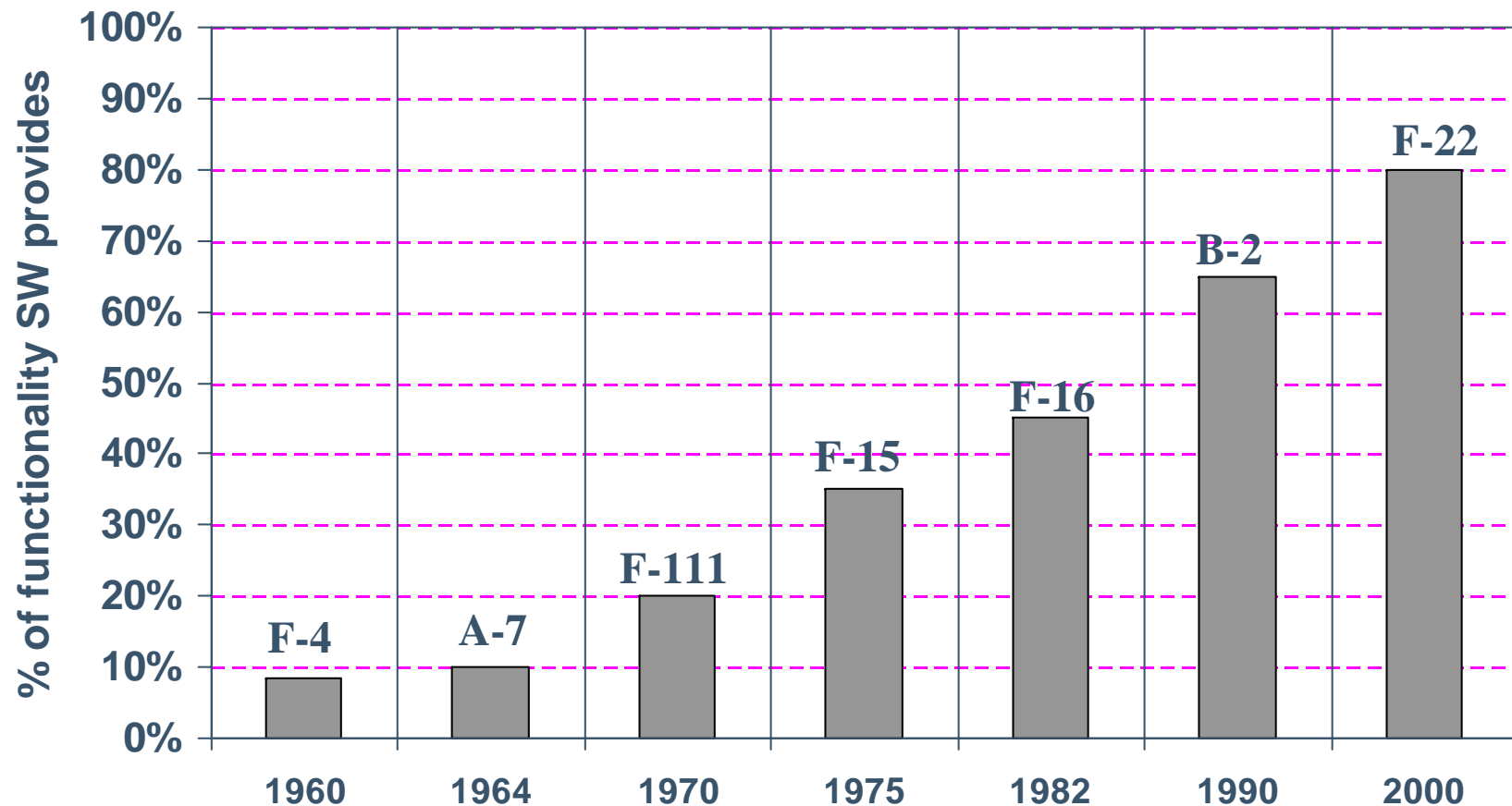
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CMMI ®

- **JSF**
- UAVs
- NCW
- Inter-System Operability

F/A-18E/F 17101K

F/A-18C/D SMUG/ RUG 14268K

F/A-18C/D XN-8 6629K

F/A-18 Night Attack 3054k

AV-8B Radar 3748K

F-14D 416K

F-14B 2866K

EA-6B ICAP2 BLK 86 779K

EA-6B ICAP2 BLK 89 2203K

F/A-18C/D 2130K

F-14B 364K

EA-6B ICAP2 BLK 82 395K

AV-8B Night Attack 1780K

AH-1 NTS 1000K

AH-1 764K

A-E SWIP 364K

F/A-18A/B 943K

AV-8B 764K

A-6E 64K

A-4 (ARBS) 16K

F-14 80K

E-A6B ICAP1 48K

A-7E 16K

KSLOC (y-axis): 0, 3000, 6000, 9000, 12000, 15000, 18000

Aircraft IOC, Year (x-axis): 66, 70, 74, 78, 82, 86, 90, 94, 98, 02, 06, 10

•M1-Background v0.1

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What Can Be Done?

Based on the premise that

> *The quality of the product is governed largely by the process used to create the product*

We could improve the Supplier's process and practices

- But the developers have a head start (CMMI-based improvement programs are widespread)

We could improve the Acquirer's processes and practices by:

- increasing the visibility of the acquirers contribution to program success
- defining, implementing, measuring and evolving effective acquisition processes and practices

Why Focus on Process?

Process provides a constructive, high-leverage focus...

- **as opposed to a focus on people**
  - Your work force, on the average, is as "good" as it is *trained* to be.
  - Working harder is not the answer.
  - Working smarter, through process, is the answer.

- **as opposed to a focus on *technology***
  - Technology applied without a suitable roadmap will not result in significant payoff.
  - Technology provides the most benefit in the context of an appropriate process roadmap

How Do You Want to Work?

- Random motion – lots of energy, not much progress

- No teamwork - each person goes his own way

- Frequent conflict

- You never know where you'll end up

- Directed motion – every step brings you closer to the goal

- Coordinated efforts

- Cooperation

- Predictable results

Process can make the difference

What's the Alternative?

Progress, if any, is the result of individual heroics
- No hero = no progress
- New hero = start over

Diverse and parochial methods for every effort
- Lack of predictability - how = f(who, when)
- Lack of cooperation - Heroes often don't work well together
                               - "Be reasonable. Do it my way!"
                                 - No sharing of "lessons learned"
- Continual retraining - Which method will you train

Why is Process Important?

Because process failure can be catastrophic

Process failure can result from:

- Improper implementation
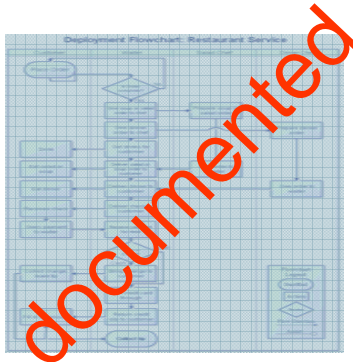- Lack of discipline
- Noncompliance
- Poor execution

Microsoft
werPoint Presentati

Petrobras oil platform

- Significant construction cost savings from bypassing rigid QA processes
- Sunk before commissioning

Characteristics of Effective Processes

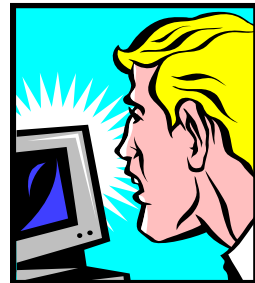documented

simple

trackable

enforced

trained

measurable

flexible

Well-defined gates

practiced

supported

STABLE

CMMI in a Nutshell

CMMI provides guidance for improving an organization's processes and ability to manage the development, acquisition, and maintenance of *products* or *product components*.

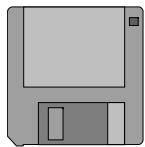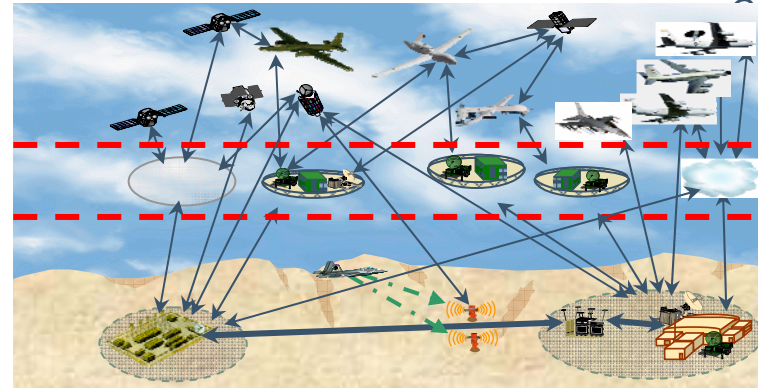CMMI places proven approaches into a structure that

- helps your organization examine the effectiveness of your processes

- establishes priorities for improvement

- helps you implement these improvements

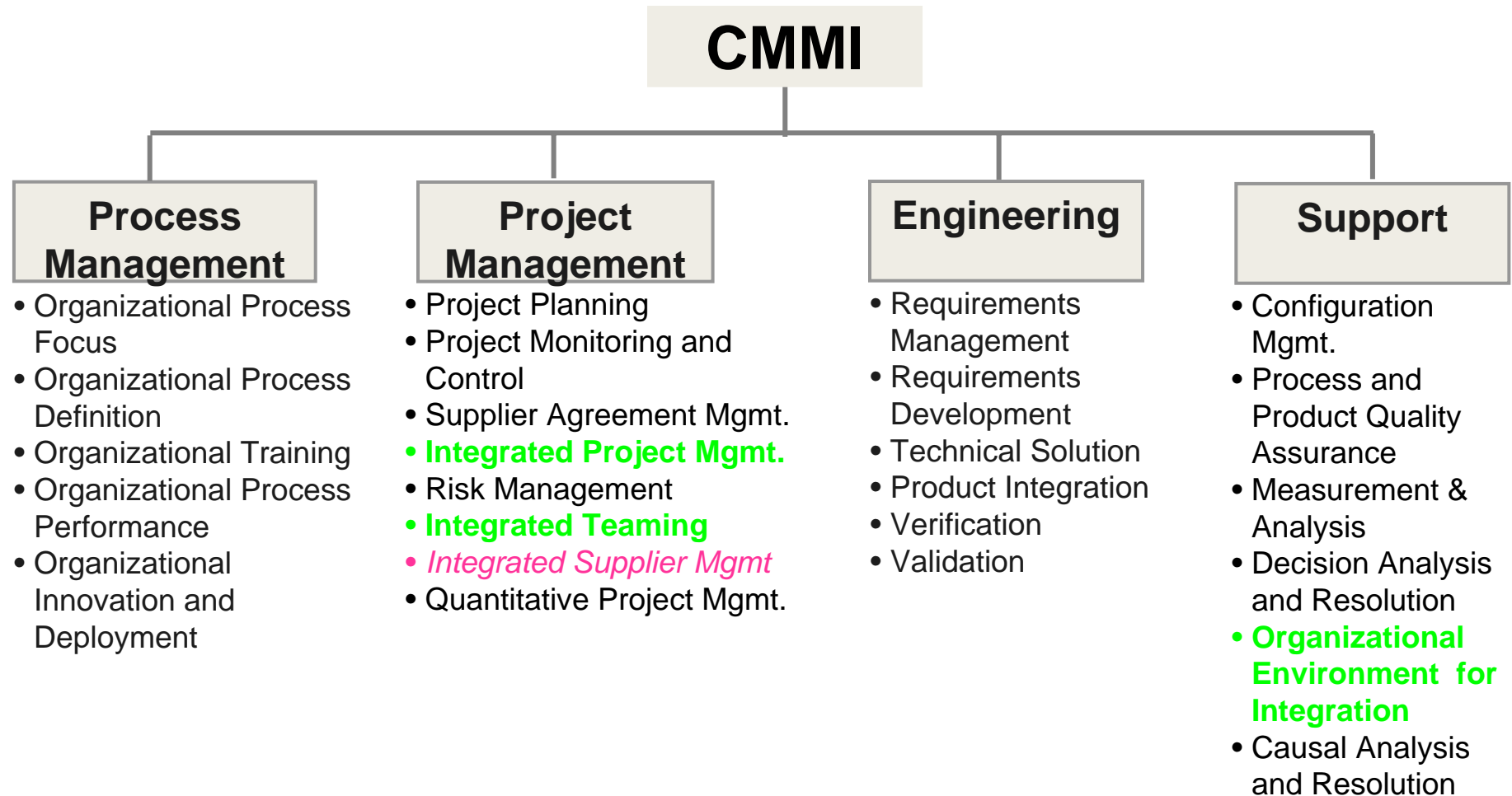*Improving processes for better products*

Focus of CMMI

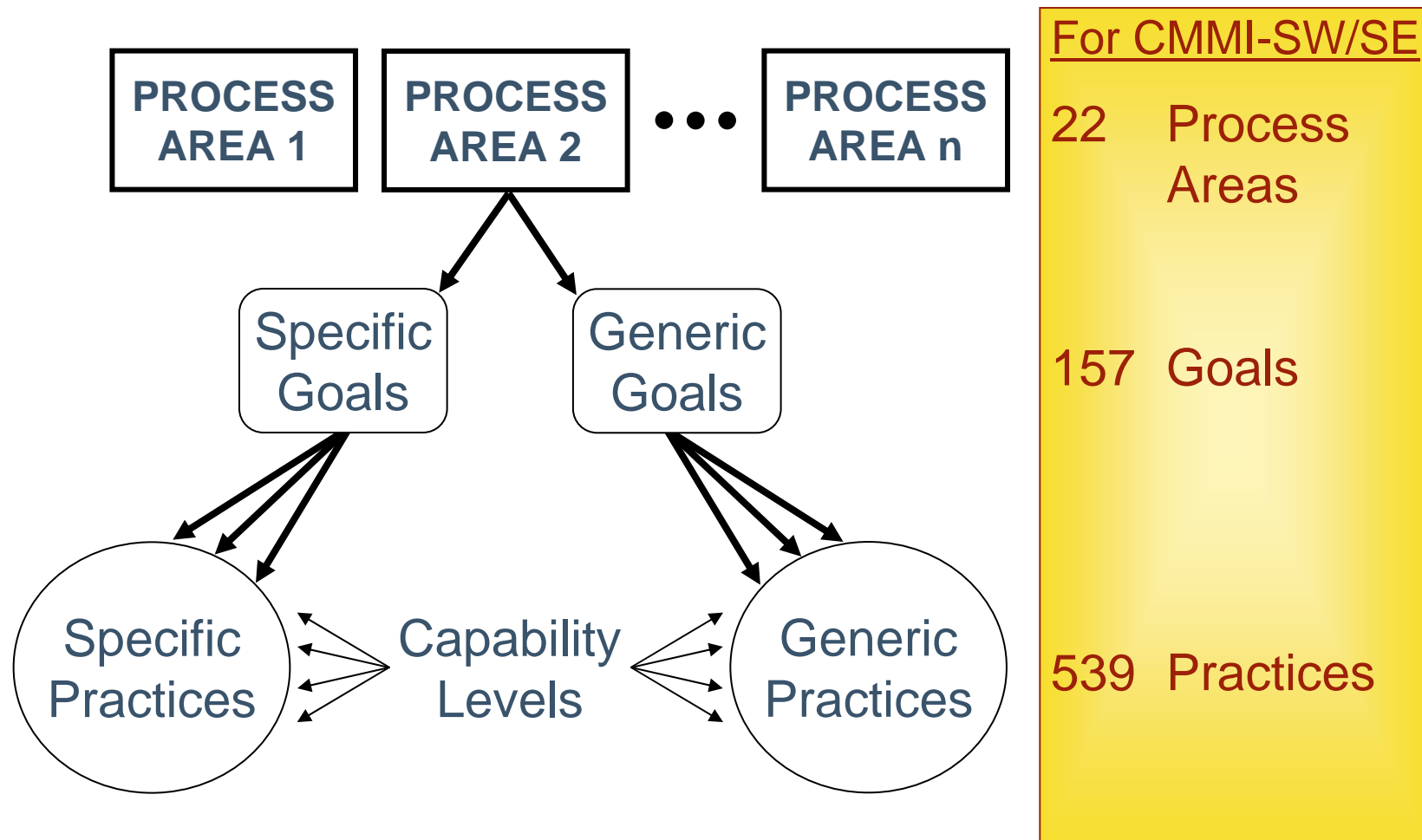**CMMI is applied here**

SW-CMM is applied here

•M1-Background v0.1
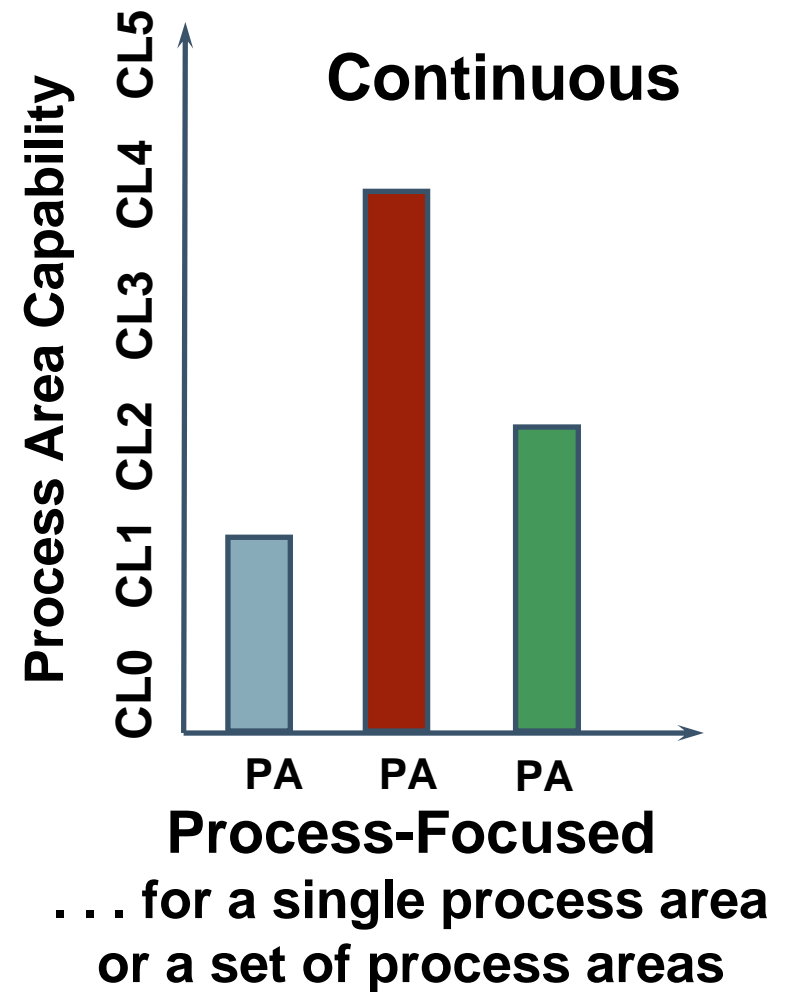
CMMI - Continuous SE/SW/IPPD/SS

CMMI

Process Management	**Project Management**	**Engineering**	**Support**

Process Management
- Organizational Process Focus
- Organizational Process Definition
- Organizational Training
- Organizational Process Performance
- Organizational Innovation and Deployment

Project Management
- Project Planning
- Project Monitoring and Control
- Supplier Agreement Mgmt.
- **Integrated Project Mgmt.**
- Risk Management
- **Integrated Teaming**
- *Integrated Supplier Mgmt*
- Quantitative Project Mgmt.

Engineering
- Requirements Management
- Requirements Development
- Technical Solution
- Product Integration
- Verification
- Validation

Support
- Configuration Mgmt.
- Process and Product Quality Assurance
- Measurement & Analysis
- Decision Analysis and Resolution
- **Organizational Environment for Integration**
- Causal Analysis and Resolution

Perspectives on Maturity

Staged

ML5
ML4
ML3
ML2
ML 1

Organization-Focused
. . . for an established set of process areas across an organization

Continuous

Process Area Capability
CL5 CL4 CL3 CL2 CL1 CL0

PA   PA   PA

Process-Focused
. . . for a single process area or a set of process areas
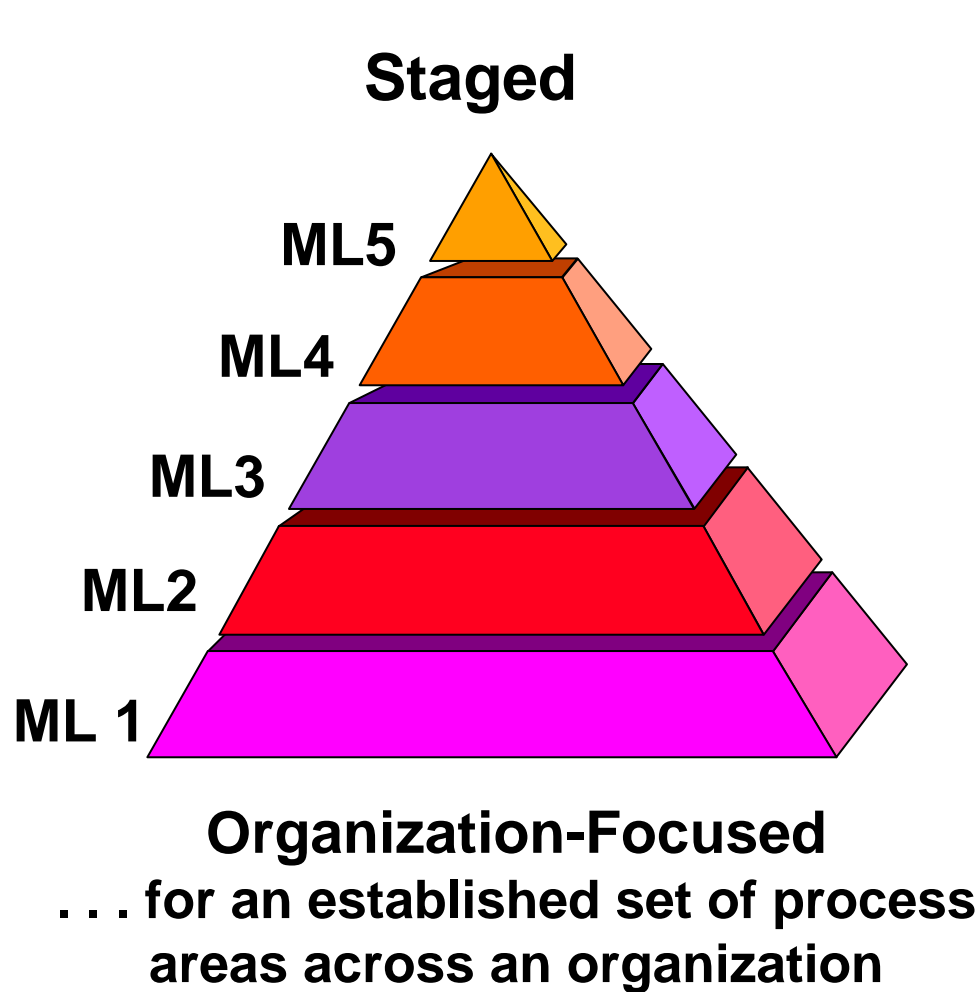
CONTRACTOR AND PROCESS
What Levels Tell Us

Levels are good indicators of *potential organizational performance*

They describe how the next project *could perform* based on a sampling of existing projects

Capability Levels and Maturity Levels reside at the organizational level (corporation, major division) and are <u>not</u> an indication of how any individual project *is performing*

Note: Sometimes a project is large enough to be considered an organizational unit (e.g. JSF, C-17)

Summary

Acquisition is a challenging multi-disciplinary effort occurring in a difficult environment, and demands for greater capabilities and increasing complexity are adding to this challenge.

Capable performance by **BOTH** the acquirer and the supplier are essential to program success

A focus on **PROCESS** at the acquirer and at the supplier can help.

CMMI is a **proven** and **widely accepted** process improvement model